

**SINGLE LINK HINGE ASSEMBLY WITH BREAK-AWAY LINK****Background of the Invention**

U.S. Patent No. 6,453,510, the disclosure of which is hereby expressly incorporated by reference herein, describes a 5 single link hinge assembly. FIGURES 1-4 of the present application illustrate such a single link hinge assembly 10 as described in the 6,453,510 patent. The hinge assembly 10 includes an elongated channel member 12 preferably defined from a U-shaped member that defines a longitudinally extending 10 recess 14 in a front face. The channel member extends axially between first and second opposite ends 16,18.

A claw member 20 is pivotally connected to the channel 12 adjacent the first end 16 at a pivot point 22 by way of a transverse rivet or other fastener 24. Thus, the channel 12 15 is adapted for pivoting movement relative to the claw 20 about the pivot point 22 on an arc **E** in respective first and second opposite directions **E1,E2**. The channel is movable on the arc **E** to and between a first operative position (FIGS. 1-3) and a second operative position (FIG. 4). As is generally known in 20 the art, the claw 20 is adapted for connection to an appliance frame or chassis, such as that of an oven or the like, and the channel is adapted for connection to an appliance door, such as an oven door. Thus, the hinge assembly 10 (typically provided in a pair) is adapted for supporting an appliance 25 door relative to the appliance frame so that the door is pivotally movable between a closed position that corresponds to the first operative position of the channel 12, and an open position that corresponds to the second operative position of the channel 12. The transverse rivet 24, or a sleeve,

bushing, roller or other member 24' (FIG. 3) held thereby in recess 14, provides a link stop 40a, the purpose of which is described in full detail below.

In addition to being interconnected at the pivot point 22, the claw and channel 12 are operably interconnected by a link assembly 30 comprising a single link member 32 and a spring 34. A first end 32a of the link member 32 is pivotally connected to a central region of the claw 20 by a rivet 36, and a second end 32b of the link member 32 is connected to a first end 34a of the spring 34. The second end 34b of the spring is fixedly secured to the channel member 12, preferably adjacent the channel member second end 18 or at least at a point axially spaced from the first end 16 of the channel member 12. As shown herein, spring 34 is a coil spring conformed with hooks at both its first and second ends 34a,34b -- the hook at the spring first end 34a adapted to engage an aperture 38 or other portion of the link member 32, and the hook at the spring second end 34b adapted to engage a projecting portion 19 of the channel second end 18. The link member 32 also defines opposite first and second contact surfaces or edges 42a,42b, respectively.

The hinge assembly 10 further comprises a link control member 40b, preferably provided in the form of a sleeve or roller 25' (FIG. 3) supported on a rivet or other fastener 25 and spanning the recess 14 adjacent the second contact surface 42b of the link member 32. The link member 32 is located between the link stop 40a and the link control member 40b.

As shown in FIG. 1, a first end of the second link

contact surface **42b** defines a projecting lobe **44** that is conformed to engage the link control member **40b** when the channel **12** is moved to its first operative position. The lobe **44** urges the link control member **40b** and, thus, the channel member **12**, away from the link member **32** to hold the channel member **12** in its first operative position. The second end **46** of the second contact surface **42b** is conformed to curve smoothly toward the channel member **12**. Notably, for reasons described below, no dwell point need be defined in the second end **46** of the surface **42b**. This allows the link member **32** to be smaller in size

The spring **34** is preferably a coil spring that normally biases the channel **12** into its first operative position. When the channel is in its first operative position, the spring **34** is relatively but not completely relaxed. Upon movement of the channel **12** in the first direction **E1** on the arc **E** toward the second operative position, the spring **34** elongates and is tensioned. As the spring elongates, the link **32** moves toward the first end **16** of the channel **12**, with the link control member **40b** preferably continuously engaging the second contact surface **42b** of the link **32** as this movement occurs.

With particular reference to FIGURE 4, when the channel **12** is moved fully into its second operative position, the link control member **40b** is engaged with the second end **46** of the second link contact surface **42b** which causes the link **32** to be urged away from the channel **12**, i.e., outwardly of the channel recess **14**. The first contact surface **42a** of the link **32** engages and is held in engagement with the link stop **40a**.

Those of ordinary skill in the art will recognize that, owing to the fact that the first and second contact surfaces **42a,42b** of the link member **32** are in respective contact with link stop **40a** and link control member **40b** when the channel member **12** is in its second operative position, the channel member **12** is unable to pivot farther in the first direction **E1**, i.e., engagement of the first and second link contact surfaces **42a,42b** with the stop **40a** and control member **40b**, respectively, provides a stop that defines the second operative position of the channel member **12**.

When the channel **12** is in its second operative position as shown in FIGURE 4, the link **32** is wedged into engagement with the link stop **40a** and link control member **40b**, and is also held in position by the fastener **36** that connects the link **32** to the claw **20**. With the link **32** so positioned, application of force on the channel member **12** in an effort to move it further in the first direction **E1** beyond the second operative position causes the force to be distributed in a triangular pattern between the link stop **40a**, the link control member **40b**, and the connection point **36**. When the channel **12** is in its second operative position, the link **32** is engaged with and supported by the link stop **40a**, the control member **40b**, and the rivet or other fastener **36**.

Double link hinge assemblies including various break-away link structures are known and comprise multiple aligned links **32** for added strength. These are more expensive to manufacture as compared to single link hinge assemblies. For this and other reasons, it has been deemed desirable to

provide a single-link hinge assembly, such as the hinge assembly 10, with a self-contained "over-open" or break-away mechanism (i.e., one not relying upon external components) that allow the channel member 12 to pivot relative to the claw 5 in the first direction E1 beyond the second operative position described above to a break-away position upon application of sufficient break-away force to the channel member 12 or an appliance door connected thereto for preventing damage to the appliance frame and/or the hinge assembly and to prevent 10 tipping of the appliance.

#### Summary of the Invention

In accordance with a first aspect of the invention, a hinge assembly comprises a claw and a channel pivotally connected to the claw at a first pivot point and adapted for movement on an arc in a first direction and in a second direction opposite the first direction. The channel is movable from a first operative position in the first direction to a second operative position, and further in the first 15 direction to a break-away position. A link control member is connected to the channel. A spring has first and second ends, and the second end is operably engaged with the channel. A single link member defines first and second opposite contact surfaces and first and second opposite ends. The first end is 20 pivotally connected to the claw and said second end operably engaged with the first end of the spring. The second contact surface of the link member abuts the link control member and defines: (i) a peak; (ii) an operative surface portion on a first side of the peak that cooperates with the peak to define 25

a first dwell point; and, (iii) a break-away surface portion on a second side of the peak. The link member is movable relative to the link control member in response to pivoting movement of the channel relative to the claw. The link 5 control member is in contact with the operative surface portion of the link when the channel is located in the first operative position; the link control member is located in the first dwell point when the channel is located in the second operative position; and, the link control member is in contact 10 with the break-away surface portion of the link when the channel is located in the break-away position.

In accordance with another aspect of the present invention, an oven comprises a frame, a door, and at least one hinge assembly that movably connects the door to the frame. 15 The at least one hinge assembly comprises a claw connected to the frame, and a channel connected to the door. The channel is also pivotally connected to the claw at a first pivot point and is adapted for movement on an arc in a first direction and in a second direction opposite the first direction. The 20 channel is movable from a first operative position in the first direction to a second operative position, and further in the first direction to a break-away position, wherein: (i) the first operative position corresponds to a fully closed position of the door relative to the frame; (ii) the second 25 operative position corresponds to a fully open operative position of the door relative to the frame; and, (iii) the break-away position corresponds to a non-operative over-open position of the door relative to the frame where the door is non-horizontal. A link control member is connected to the 30 channel. A spring has first and second ends, and the second

end operably engaged with the channel. A single link member defines first and second opposite contact surfaces and first and second opposite ends. The first end is pivotally connected to the claw and the second end is operably engaged with the first end of spring. The second contact surface of the link member abuts the link control member and defines: (i) a peak; (ii) an operative surface portion on a first side of the peak that cooperates with the peak to define a first dwell point; and, (iii) a break-away surface portion on a second side of the peak. The link member is movable relative to the link control member in response to pivoting movement of the channel relative to the claw. The link control member is in contact with the operative surface portion of the link when the channel is located in the first operative position; the link control member is located in the first dwell point when the channel is located in the second operative position; and, (iii) the link control member is in contact with the break-away surface portion of the link when the channel is located in the break-away position.

In accordance with a further aspect of the invention, a hinge assembly for connecting an appliance door to an appliance frame is disclosed. The hinge assembly includes a claw and a channel pivotally connected to the claw. A single link member is pivotally connected to the claw, and the link member defines first and second contact surfaces. The second contact surface defines an operative portion and a break-away portion separated from the operative portion by a peak that projects outwardly from the second contact surface. A spring is operably engaged between the link member and the channel. A link control member is connected to the channel and contacts

the second contact surface of the link member. The channel is movable from a first operative position in a first direction on arc of 90 degrees or less to a second operative position where said link control member is in contact with the 5 operative portion of the second contact surface of the link. The channel is movable from the second operative position further in the first direction to a break-away position that is more than 90 degrees from said first operative position where the link control member is in contact with the break-10 away portion of the second contact surface of the link.

**Brief Description of the Drawings**

The invention comprises a variety of components and arrangements of components, preferred embodiments of which are 15 illustrated in the accompanying drawings that form a part hereof and wherein:

FIGURE 1 (prior art) is a side elevational view of a single-link hinge assembly in a first operative position;

FIGURE 2 (prior art) is a bottom view of the hinge 20 assembly shown in FIGURE 1;

FIGURE 3 (prior art) is a front elevational view of the hinge assembly shown in FIGURE 1 as taken along view line 3-3;

FIGURE 4 (prior art) is a side elevational view of the hinge assembly shown in FIGURE 1 in a second operative 25 position;

FIGURES 5 is a side elevational view of a break away hinge assembly with break-away link formed in accordance with the present invention in a first operative position;

FIGURE 5A is an enlarged side elevational view of the 30 break-away link portion of the hinge assembly shown in FIG. 5;

FIGS. 5B-5D are side elevational views of the hinge assembly of FIG. 5 (without showing the spring) in broil, second and break-away operative positions, respectively;

FIGURE 6 illustrates a single link hinge assembly with 5 break-away link formed in accordance with an alternative embodiment of the present invention;

FIGURE 6A is an enlarged side elevational view of the break-away link portion of the hinge assembly shown in FIG. 6;

FIGURE 7 illustrates a single link hinge assembly with 10 break-away link formed in accordance with another alternative embodiment of the present invention; and,

FIGURE 7A is an enlarged side elevational view of the break-away link portion of the hinge assembly shown in FIG. 7.

15 **Detailed Description of the Preferred Embodiment**

FIGURES 5 shows a hinge assembly 110 formed in accordance with the present invention operatively connected a frame or chassis 0 of an oven or other appliance. More particularly, the hinge assembly 110 comprises an elongated channel member 20 112 preferably defined from a U-shaped member that defines a longitudinally extending recess 114 in a front face. The channel member 112 extends axially between first and second opposite ends 116,118.

A claw member 120 is pivotally connected to the channel 25 112 adjacent the first end 116 at a pivot point 122 by way of a transverse rivet or other fastener 124, and the fastener 124 supports a coaxial sleeve, bushing, roller or the like 124' that at least partially transversely spans the recess 114 of channel 112. In this way, the channel 112 is adapted for

pivoting movement relative to the claw 120 about the pivot point 122 on an arc **E** in respective first and second opposite directions **E1, E2**.

The channel 112 is movable on the arc **E** to and between a 5 first operative position as shown in FIG. 5 and a second operative position shown in FIG. 5C. As is generally known in the art, the claw 120 is adapted for connection to an appliance frame or chassis **O**, such as that of an oven or the like, and the channel 112 is adapted for connection to an 10 appliance door **D** (FIG. 5), such as an oven door. The hinge assembly 110 (typically provided in a pair) is adapted for supporting an appliance door **D** relative to the appliance chassis **O** so that the door is pivotally movable between a closed position that corresponds to the first operative 15 position of the channel 112 (FIG. 5), and an open position (for access to a cooking chamber or other space) that corresponds to the second operative position of the channel 112 (FIG. 5C). The transverse rivet 124, in combination with the sleeve 124', preferably defines a link stop 140a, the 20 purpose of which is described in full detail below.

In addition to being interconnected at the pivot point 122 by fastener 124, the claw 120 and channel 112 are operably interconnected by a link assembly 130 that comprises a single link member 132 and a spring 134. A first end 132a of the 25 link member 132 is pivotally connected to a central region of the claw 120 by a rivet or other fastener 136, and a second end 132b of the link member 132 is connected to a first end 134a of the spring 134. The second end 134b of the spring is

fixedly secured to the channel member **112**, preferably adjacent the channel member second end **118** (or at least at a point axially spaced from the channel first end **116**). As shown herein, it is most preferred that, in order to minimize the 5 use of fasteners such as rivets, the spring **134** be a coil spring conformed with hooks at both its first and second ends **134a,134b**; the hook at the first end **134a** is adapted to engage an aperture **138** or other portion of the link member **132**, and the hook at the second end **134b** is adapted to engage a portion 10 **119** of the channel second end **118** or a structure connected thereto. The link member **132** also defines opposite first and second contact surfaces or edges **142a,142b**, respectively.

The hinge assembly **110** further comprises a link control member **140b** connected to the channel **112** and located in recess 15 **114**. The link control member **140b** is preferably defined by a rivet or other fastener **125** connected to the channel **112** and spanning recess **114**, and including a sleeve, bushing, roller or the like **125'** coaxially supported thereon and extending transversely at least partially across recess **114**. The link 20 control member **140b** is spaced axially from the link stop **140a** and is located adjacent the second contact surface **142b** of the link member **132**. As such, the link member **132** is located between the stop **140a** and the control member **140b**, with the first link contact surface **142a** oriented toward the stop **140a** 25 and the second link contact surface **142b** oriented toward the control member **140b**.

The second link contact surface **142b** defines a projecting lobe **144** that is conformed to engage link control member **140b**

when the channel **112** is in its first operative position. The lobe **144** urges the link control member **140b** and, thus, the channel member **112**, away from the link member **132** so as to hold the channel member **112** in its first operative position 5 with greater "pull-in" force. The lobe **144** also cooperates with the link control member **140b** so that the channel member **112** (including a door **D** connected thereto) counter-balances in an intermediate "broil-stop" position as shown in FIG. 5B when channel member **112** is moved manually to this position on the 10 arc **E**.

With reference also to FIG. 5A where the link **132** is shown by itself, the second link contact surface **142b** preferably also comprises a cusp or peak **147** projecting outwardly therefrom that divides the second contact surface 15 **142b** into an operative portion **142b-1** and a break-away portion **142b-2**. A first dwell point **146a** is defined at the intersection of the peak **147** and the operative surface portion **142b-1** and is preferably defined by a radiused surface that is dimensioned to mate with the link control member **140b**. The 20 first dwell point **146a** is adapted to receive and retain the link control member **140b** therein when the channel **112** is pivoted to its second operative position as shown in FIG. 5C. In the embodiment illustrated in FIGS. 5 and 5A-5D, the break-away surface portion **142b-2** cooperates with peak **147** to define 25 a second dwell point **146b** that comprises a cylindrical recess dimensioned to receive link control member **140b** when break-away surface portion **142b-2** moves adjacent link control member **140b** (FIG. 5C).

The spring 134 is preferably a coil spring that normally biases the channel 112 into its first operative position (FIG. 5). When the channel 112 is located in its first operative position, the spring 134 is relatively shortened and partially relaxed. Upon movement of the channel 112 in the first direction **E1** on the arc **E** toward the second operative position (FIG. 5C), the spring 134 elongates and is tensioned as the claw 120 pulls the link 132 downward toward channel first end 116. As the link 132 moves toward the first end 116 of the channel 112 against the biasing force of the spring, the second contact surface 142b of the link 132 rides on link control member 140b which preferably comprises a roller to facilitate this action.

With particular reference to FIGURE 5C, when the channel 112 is moved fully into its second operative position, the link control member 140b seats in the first dwell point 146a. Under normal/intended operation, the channel 112 is never pivoted in the first direction **E1** beyond the second operative position as shown in FIG. 5C, and the weight of door D in combination with the shape of link 132 and its relationship with link control member 140b and spring 134 ensures that the channel 112 and door D counter-balance in the second operative position. Peak 147 ensures that link 132 is resistant to further movement toward channel first end 116 relative to link control member 140b that would cause peak 147 to move past link control member 140b so that break-away surface portion 142b-2 contacts the link control member 140b. If, however, sufficient excessive break-away force is applied to channel

112 (or door D to which it is connected) in the direction E1 such as, e.g., a person placing his/her full or partial weight on the door D, link 132 will move further toward channel first end 116 relative to link control member 140b so that peak 147 of link 132 moves past link control member 140b and so that the channel 112 is allowed to pivot further in the first direction E1 to a break-away or "over-open" position (FIG. 5D) (spring 134 elongates further to accommodate the movement). In this break-away position as shown in FIG. 5D, the link control member 140b seats in second dwell point 146b. The exact angle of the channel member 112 relative to the appliance chassis O in the break-away position can vary, but it is deemed desirable to define the break-away position such that the door D connected to the channel member 112 is sloped (moved past horizontal) to a position where a child or other unsafe load (e.g., a turkey) slides off of the door D.

When the channel member 112 is located in the second operative position, an angle A (FIG. 5C) of no more than 90 degrees is defined between the channel member 112 and a vertical portion of the appliance frame O to which the hinge assembly 110 is connected, i.e., the channel member 112 does not move past horizontal. As shown in FIG. 5D, however, in break-away position, the channel member 112 has moved beyond a horizontal state so that it defines an angle A with the vertical member of the appliance frame O that is greater than 90 degrees. Stated another way, the channel 112 moves no more than 90 degrees from its first operative position to its second operative position, and is moved more than 90 degrees

from its first operative position to the break-away (over-open) position. By allowing the channel member 112 to pivot beyond the second operative position (FIG. 5C) to the break-away position as described, damage to the hinge assembly 110 or appliance chassis or frame 0 is prevented, and tipping of the appliance is also prevented. The first contact surface 142a of link 132 abuts link stop 140a when the channel 112 is pivoted to the break-away position as shown in FIG. 5D. This abutment of first link contact surface 142a with stop 140a prevents pivoting movement of channel 112 in the first direction E1 beyond the break-away position and also prevents movement of link 132 outwardly of recess 114. Also, when first link contact surface 142a engages stop 140a, the stop supports link 132 and prevents deformation of same and/or damage to the link control member 140b.

In the illustrated embodiment, once the channel 112 moves into the break-away position as shown in FIG. 5D, the force of spring 134 alone is insufficient to overcome the weight of the door and engagement of the link control member 140b with second dwell point 146b so as to return the channel 112 and link 132 to the second operative position. Instead, the hinge assembly 110 must be manually re-set by application of force to channel 112 (or door D to which channel is connected) in the second direction E2 opposite the first direction so that link 132 will move away from first channel end 116, with peak 147 moving over link control member 140b, so that the link control member 140b is once again moved into the first dwell point 146a or further onto the operative surface portion 142b-

1. Whether or not the hinge assembly 110 must be manually re-set after the channel 112 is moved into the break-away position can be controlled by the shape of the link 132 as described below. In certain applications, it has been deemed  
5 desirable to shape the link 132 such that an end-user can never manually re-set the hinge assembly 110 and must call a service technician. This can be accomplished by forming the link 132 so that, once the link control member 140b moves over the peak 147, simple application of force on the channel  
10 member 112 in the opposite direction **E2** is not sufficient to accomplish the re-set operation. This can be accomplished by forming the peak 147 with an undercut or the like.

The select force required to move the channel 112 from the second operative position to the break-away position can  
15 vary depending upon the force of spring 134 and the profile of the link 132.

The link 132 can be formed alternatively as described below in relation to FIGS. 6, 6A, 7 and 7A. Except as otherwise shown and/or described, the hinge assembly 210 shown  
20 in FIG. 6 is identical to the hinge assembly 110 described above (spring 234 is shown on partially for clarity). As such, like components of the hinge assembly 210 relative to the hinge assembly 110 are identified with like reference numbers that are one-hundred greater than those used in  
25 relation to the hinge assembly 110. The only difference between the hinge assembly 210 and the hinge assembly 110 is that the hinge assembly 210 comprises an alternative link member 232.

The alternative link member 232 is shown separately in FIG. 6A. There, it can be seen that the break-away surface portion 242b-2 is flat and blends into peak 247 so that peak 247 and break-away surface portion 242b-2 cooperate to define 5 the second dwell point 246b. The presence of peak 247 that extends outwardly from and separates first and second dwell points 246a, 246b still requires that the hinge assembly 210 be manually re-set (as described above in relation to the hinge assembly 110) after the link 232 moves into the break-away 10 position where link control member 240b seats in the second dwell point 246b (FIG. 6). The re-set operation is performed by manually moving channel 212 via door D pivotally in the second direction E2 opposite the first direction E1. As shown in FIGURE 6, the channel member 212 is unable to pivot in the 15 first direction E1 beyond the break-away position owing to the abutment of the first link contact surface 242a with the stop 240a while the link control member 240b is seated in the second dwell point 246b.

Referring now to FIGS. 7 and 7A, another alternative 20 hinge assembly 310 is shown. Here, again, except as otherwise shown and/or described, the hinge assembly 310 is identical to the hinge assembly 110 described above (spring 334 is shown only partially for clarity). As such, like components of the hinge assembly 310 relative to the hinge assembly 110 are 25 identified with like reference numbers that are two-hundred greater than those used in relation to the hinge assembly 110. The only difference between the hinge assembly 310 and the hinge assembly 110 is that the hinge assembly 310 comprises

and alternative link member 332. The link member 332 is shown separately in FIG. 7A. There, it can be seen that the break-away surface portion 342b-2 is flat and blends directly into the first dwell point 346a, i.e., the break-away surface 342b-5 2 is flat and defines one face of peak 347. As such, when the hinge assembly 310 is manipulated into the break-away position as shown in FIG. 7, the link control member 340b lies in contact with the flat break-away surface 342b-2. Upon removal or lessening of the break-away force being applied to channel 10 312 or door D connected to channel 312, the spring 334 urges channel 312 in the second direction E2 until link 332 moves relative to link control member 340b away from the channel first end 316 sufficiently for the link control member 340b to seat in first dwell point 346a defined at the intersection of 15 operative surface 342b-1 with peak 347. Hinge assembly 310 automatically re-sets under biasing force of spring 334 from the break-away position to the second operative position upon reduction or removal of the break-away force that caused the hinge assembly 310 to move into the break-away position.

20 As noted, it is preferred that the link member 132,232,332 abut link stop 140a,240a,340a when the channel member 112,212,312 is moved into the break-away position as shown in FIGS. 5D, 6 and 7, respectively, to prevent further pivoting of channel member 112,212,312 in first direction E1. 25 This structure is also important in that it allows the single link member 132,232,332 to resist deformation when the channel 112,212,312 is moved into the break-away position, i.e., a group of two or more link members 132,232,332 is not required

for added strength and thickness of links 132,232,332 can be reduced. When the channel 112,212,312 is moved fully to the break-away position, the link 132,232,332 is wedged between the stop 140a,240a,340a and link control member 140b,240b,340b. The link 132,232,332 is also held in position by the rivet or other fastener 136,236,336 that connects the link to the claw 120,220,320. As such, application of force on the channel member 112,212,312 in an effort to move it further in the first direction E1 beyond the break-away position causes this force to be distributed in a triangular pattern between the stop 140a,240a,340a, link control member 140b,240b,340b, and claw connection fastener 136,236,336.

The invention has been described with reference to preferred embodiments. Of course, modifications and alterations will occur to others upon a reading and understanding of the preceding specification. It is intended that the invention be construed as including all such modifications and alterations.